1. To provide a set of questions that students can use to diagnose what they know and don't know about Freshman Chemistry.

2. To tie theoretical ideas to practical applications wherever possible.

> Example: A question ask the student to define "standard state": the student answers that "it is the form of an element that is most stable at a particular temperautre of interest and at standard atmospheric pressure.
>
> Below the answer there are two short paragraphs (with a disclaiming stating the student won't need the information for the test--they have enough to memorize already :) that talk about how an aviation engineer is concerned with molecular oxygen (O2) dissociating at the high temperatures of a scramjet operating at speeds of Mach 6 and higher.

3. To insure that every student who goes through my Freshmen Chemistry course walks away with an sense of intrigue for Organic Chemistry, Physical Chemistry, Ceramics, Chemical Engineering, Nuclear Engineering, and any other physical science discipline that can be worked into the format.

Energy, Enthalpy, and Thermochemistry

Vasquez (Aliens) is a Colonial Marine who lifts weights. What equationfrom your text can be used to calculate the work performed each time she benches 70 kg for her warmup?

The Systeme Internationale (SI) units for energy is the ________.

Exactly how many joulesin one calorie?

How many caloriesin 1 nutritional Calorie?

System tend to change to reach the highest/lowest energy possible.

The first law of thermodynamics is the conservation of ______.

Delta E = E(final/initial) - E(final/initial).

Delta E > 0 indicates that the system gains/loses energy from its surroundings.

What are the two mechanisms we have studied so far that transfer energy? What thermodynamics equation sums up this idea?

Delta H = H(products/reactants) - H(products/reactants .)

For an endothermic/exothermic reaction, the products have a lower enthalpy of reaction than the reactants.

---

a) 2 H2(g) + O2(g) -> 2 H2O(g) Delta H = -483.6 kJ
-
b) 1 H2(g) + (1/2) O2(g) -> 1 H2O(g) Delta H = -241.8 kJ
-
where 241.8 = 483.6 divided by 2

(a is correct; b is correct, both are correct.)

The measure of heat flow is called ____________.

What is the definition of heat capacity?

What are the units of specific heat?

Combustion reactions are carried out in a ___________ filled with what gas and what liquid?

The heat capacity of the calorimeter is lower case, upper case c/C.

Name the two enthalpies that deal with phase transition.

The standard state of a substance is ...

For Delta H (superscripted circle), what type of condition does the superscripted circle indicate?

The conversion of graphite to diamond requires/ gives off energy:

-

C (graphite) -> C (diamond)

-

Delta H (superscripted circle) = 1.88 kJ

Which chemical has an enthalpy of formation equal to zero? H2O (g), H2O (l), O2 (g)

What is the definition of fuel value?

What chemical does your body convert carbohydrates to?

Name three fossil fuels:

What is the composition of natural gas?

---

work = force times distance of lift (assume perfect vertical lift)

.

you may recall that force is mass multiplied by the gravitational acceleration she is lifting against (9.8 meters per second squared at sea level on earth.)

joule

4.184 J

1000 calories

lowest

energy

final

initial

gains

heat and light

If you said radiation, that falls under light.

Delta E = q + w

---

w is work and q is heat.

---

products

reactants

exothermic

both are correct

calorimetry

The amount of heat required to raise the temperature by 1 Kelvin (1 deg C.)

Notice that Kelvin is not called 'degrees.' (you probably already knew this.)

---

joules per (grams times kelvin)

---

joules is in the numerator, and both grams and kelvin are in the denominator.

---

bomb calorimeter

oxygen

water

uppercase, C

enthalpy of vaporization, enthalpy of fusion

the form most stable at a particular temperature of interest and at standard atmospheric pressure.

(The below won't be on a test; it was added to make things interesting.)

TEMPERATURE OF INTEREST- the often will be "ambient temperature", around 22 deg C. However, if you are working with hypersonic aviation, and you want to work with a scramjet at speeds above Mach 6, you will be concerned with temperatures at which molecular oxygen (O2) dissociates to atomic oxygen, in a reaction that is endothermic, and this is a problem for you to contend with.

As a hypersonic aviation specialist, you will be considering temperatures in the other extreme (low temperature) where hydrogen is in a solid or a "slush" state (I'm paraphrasing what I heard at the AIAA meeting) so that it will have a much higher density, such that you can store a lot more of it in a given volume; weight/size constraints are some of the challenges that hypersonic aviation specialists are investigating.

---

it indicates standard conditions

requires

O_2 (g)

The energy released when 1 g of material is combusted.

glucose

coal, petroleum, and natural gas

gaseous hydrocarbons, compounds of hydrogen and carbon.

Electronic Structure of Atoms, Light, and Quantum Mechanics

The spectrum of light through a prism is continuous/discrete and a line spectrum from an atom is continuous/discrete.

What wavelength corresponds to a n=4 to n=2 transition for hydrogen?

Write the electron configuration for scandium.

The DeBroglie Equation relates waves and particles.

The Heisenberg Uncertainty principle concerns what two properties?>HR> Concerning Schrodinger's Equation, what is the meaning of psi squared.

The s orbital has (no nodes, a nodal point, a nodal plane, two nodal planes, the p orbital has (no nodes, a nodal point, a nodal plane, two nodal planes, the d orbital has (no nodes, a nodal point, a nodal plane, two nodal planes.

What is the effective nuclear charge?

Rank the following electrons, 3s, 3p , 3d, in order of decreasing Z(eff.)

In a many-electron atom, for a given value of n, the energy of an orbital increases/ decreases with increasing value of l.

In a many-electron atom, for a given value of n, the energy of an orbital increases/ decreases with the increasing value of l.

What is the property of the electron that makes it behave as though it were a tiny magnet?

continuous

discrete

Delta E = 1312 ((1/(2^2)) - (1/(4^2))) = 246.0 kJ mol^-1

.

--> 4.085 x E-19 J per atom --> 487 nm

1S2 2S2 2P6 3S2 3P6 3D1 4S2

Lambda = h over p

---

h is Planck's constant

---

p is momentum, or mass multiplied by velocity

---

position and momentum

remains constant

no nodes

a nodal point

two nodal planes

Z(eff) = Z - S, where

-

Z(eff) is the effective nuclear charge

-

Z is the number of protons in the nucleus

-

and S is the average number of electrons, S, that are between the nucleus and the electron in question.

Z(eff of 3s) > Z(eff of 3p) > Z(eff of 3d)

decreases

increases

Electron spin. Electron spin is quantized and is characterized by the electron behaving as though it were spinning on its axis.

PERIODIC PROPERTIES OF THE ELEMENTS

What two elements did Mendeleev predict?

What type of experiment did Moseley use to establish the concept of atomic number?

The 1s shell electrons of argon are a) closer to, b) farther from, c) the same distance from the nucleus than the 1s shell electrons of the He atom.

Within a group, the atomic radius tends to a) increase, b) decrease moving from the top to the bottom.

Within a period, the atomic radius tends to a) increase, b) decrease, c) remain the same moving from left to right.

What two factors determine the size of the outermost orbital?

Proceeding across a period in the table, the number of a) electrons, b) core electrons, c) valence electrons remains the same.

Proceeding across a period in the table, the number of valence electrons a) increases, b) decreases, c) remains the same.

Proceeding across a period in the table, the effective nuclear charge a) increases, b) decreases, c) remains the same

---

and the principle quantum number a) increases, decreases, stays the same.

In going down a column of elements, effective nuclear charge a) increases, b) decreases, c) remains the same while the principle quantum number d) increases, e) decreases, f) remains the same.

To summarize, if we think of the periodic term as having the same directions as a map (up is North), the the line of increasing atomic radius travels a)northeast, b)southeast, c) southwest, d) northwest.

The ____________ is the minimum energy required to remove an electron from the ground state of the isolated gaseous atom.

Higher ionization eneries indicate that it is easier, more difficult to remove an electron.

The idea that valence electrons are the only electrons involved in chemical reactions is supported by the observation that it is much easier, much more difficult to remove valence electrons than to remove noble gas core electrons.

Generally

Within each period, the first ionization energy is a) independent of, b) increases with, c) decreases with increasing atomic number.

Generally

Ionization energy a) remains the same, b) increases, c) decreases with increasing atomic number.

The attraction between the electron and the nucleus can be increased by either a) increasing, b) decreasing the effective nuclear charge, or a) increasing, c) decreasing the distance from the nucleus.

For our periodic table map analogy, the line of increase moves northeast, southeast, southwest, northwest for first ionization energy.

The energy change that occurs when an electron is added to a gaseous atom or ion is called the _______________

For metal characteristics vs. nonmetal characteristics, a list is provided below of two choice options. Select the characteristic that corresponds to metals (and the one you don't select applies to nonmetals:

.

.

distinguishing luster*nonlustrous; various colors**

.

malleable and ductile as solids*solids are usually brittle; may be hard or soft**

.

poor conductors of heat and electricity*good thermal and elecrical conductivity**

.

most oxides are molecular, acidic compounds*most oxides are basic, ionic solids**

.

exists in aqueous solution mainly as cations*exist in aqueous solution mainly as anions or oxyanions**

.

Metals are called _______ because they can be pounded into thin sheets (this is particularly true for gold) and _______ because they can be drawn into wire.

Nonmetals, in reacting with metals, tend to gain/lose electrons and become anions/cations.

Most nonmetal oxides dissolve in water to form a) acids, b) bases, c) compounds that are neutral.

For our map/periodic table analogy, the line of increasing metallic character heads in a northeast, southeast, southwest, northwest direction.

The process of obtaining metals by passing an electric current through a molten salt is known as __________.

For compounds of alkali metals bonded to hydrogen (LiH, NaH, etc.), hydrogen is present as H-, and is called the ________ ion.

Alkali metals react vigorously with water to produce ____________ and __________.

Give the flame test colors for lithium, sodium, and potassium.

Two examples of _______ include oxygen and ozone for O, and graphite and diamond for C.

The order of halogen reactivity from most reactive to least reactive is ________.

Halogens react directly with most metals to form ________, and with hydrogen to form ________, and dissolve in water to form ________.

What one element has been successfully reacted with Xe and Kr?

Germanium, Gallium

x-rays

A plot of x-rays vs. Z shows an incredibly straight line, the deviations from which are attributed experimental error, I assume (I didn't read the thesis which Moseley wrote, as a graduate student, from which the theory came.)

---

a) closer to

a) increase

b) decrease

1) Principle Quantum Number, 2) Effective Nuclear Charge

b) core electrons

a)increases

increases

---

this is because the number of core electrons does not change, but the nuclear charge is increasing.

---

stays the same.

Take a look at Fig. 6.28 on page 205. I worry just a bit, that the sentence for this question, which was taken directly from the book, is incorrect. You can see that if you start in the 3d column, you can go quite a ways without changing the 3, but eventually you get to 4p, and to me, that is a change in principal quantum number, (from n=3 to n=4.)

c) stays the same

d) increases

southwest

ionization energy

more difficult

much easier

b) increases with

c) decreases

increasing

decreasing

northeast

electron affinity

distinguishing luster

malleable and ductile as solids

good thermal and electrical conductivity

most metallic oxides are basic, ionic solids

exist in aqueous solution mainly as cations

malleable

ductile

gain

anions

a) acids

southwest

electrolysis

hydride

hydrogen gas, H2

and

alkali metal hydroxides, MOH(aq)

crimson red

<

yellow

purple (in the book it looks blue to me)

allotropes

F > Cl > Br > I

---

fluorine will remove electrons from just about any substance.

ionic halides

gaseous hydrogen halide

hydrohalic acids

fluoride

CHEMICAL BONDING

What are the three types (type one/ type two/ type three) of chemical bonds?

What are the electrons called that take part in chemical bonding?

Each side of an electron can contain ________ dots in an electron-dot symbol.

T or F The number of valence electrons is equal to the number of the column that the element is found in the periodic table.

Atoms will gain, lose, or share electrons in order to have _______ valence electrons.

GENERALLY

A process is classified as (endothermic,exothermic) when a nonmetal gains an electron.

The energy required to separate completely one mole of a solid ionic compound into its gaseous ions is known as its ___________ energy.

T or F The higher the lattice energy, the less strongly the ions are attracted to one another.

The attractive interaction between two oppositely charged ions increases, decreases as the magnitudes of their charges decreases and as the distance between their centers increases.

When a positive ion is formed from an atom, the electron is lost from the subshell with (smallest, largest) value of n.

A) Na +
B) Na 2+
(only A makes sense/only B makes sense/ both are logical.)

Cations are smaller/larger than the atoms from which they are prepared.

For ions of the same charge, size increases/decreases as one goes down a family in the periodic table.

F- is isoelectron to what sodium ion?

Between O 2- and Al 3+, which atom has the larger radius?

If it is brittle and has a melting point of 600 deg C, it's more likely to be covalent/ionic/ metallic.

Hermes Trismegistus transmutes the brittle, 600 deg C compound into a compound which is malleable, ductile, and still has the 600 deg C melting pointing point. The new substance makes use of bonds which are covalent/ metallic.

The nitrogen molecule consists of two nitrogen atoms bonded together by a single/ double/ triple/ quadruple bond, and each nitrogen has one/ two/ three lone pairs.

The bond distance between two carbon atoms that share a triple bond is greater/ lessthan the bond distance between two carbons atoms that share a double bond.

The ability of an atom in a molecule to attract electrons to itself is called _________.

If we treat the periodic table as if it were a map (up is north, and fluorine is directly east of oxygen), then the arrow of increasing electronegativity heads to the northeast/ southeast/ southwest/ northeast.

Ionization energy differs from electron affinity, in that electron affinity/ionization energy measures how much energy is necessary to remove an electron for a given atom, but electron affinity/ionization energy measures how strongly that atom will attract additional electrons.

An atom with a high electronegativity will have a very negative/positive electron affinity, and a high/low ionization energy.

Which diatomic molecule (two atoms) has more ionic character? HF or LiF?

The greater the difference in electronegativity, the more nonpolar/polar the bond.

When several Lewis structures are possible, the most stable structure will place a negative formal charge on the most electronegative/electropositive atom.

Draw the resonance structures of the nitrate ion.

---

why?

What is the difference between the bonding of SO3 and SO3(2-) in terms of bonds and lone pairs?

A triple bond is stronger/weaker than a double bond.

Where do the values for bond energies come from?

As the number of bonds between two atoms increases, the bond grows longer/shorter and stronger/weaker.

For sodium metal, nitrogen gas (N2), chlorine gas (Cl2), P4, or any other molecule where all atoms are the same element (this guarantees that all bonding electrons are shared equally by all atoms in the molecule), the oxidation state is _________.

The oxidation state of a monoatomic ion is _________.

In binary compounds, the element with the greater/lesser electronegativity is assigned a negative oxidation number equal to its charge in simple ionic compounds of the elements.

What is the common exception to the "oxygen has an oxidation number of -2" rule?

Ionic

Covalent

Metallic

Valence electrons

The electron-dot symbol (also known as Lewis symbols) can accomodate up to two electrons per side of the atomic symbol.

True

The octect rule states that atoms like to have EIGHT electrons in their valence shell.

Exceptions include hydrogen, sulfur, and phosporous.

Exothermic

Lattice energy

False The lattice energy is the energy required to separate the atom into its ions. Therefore, the higher the lattice energy, the stronger the ions are attracted to each other.

Decreases. This can be seen from the equation $E = (k*Q1*Q2)/d$ where Q1 and Q2 are the charges on the particles, d is the distance between their centers, and k is a constant.

Largest. This can especially be seen with the transition metals. The 5s electron of silver is removed before the 4d electron to form Ag+.

Na +

Only Na + makes sense because that involves removal of the one valence electron to form an ion which adheres to the octet rule. the removal of a second electron would require the removal of a core electron, and this would require a heck of a lt of energy.

---

smaller

Na^+, because fluorine has 9 protons, so F^- has 10 electrons and sodium has 11 protons, so Na^+ has 10 electrons.

O^{2-}

ionic

an ancient alchemist who's name translates "three times great."

metallic

To generalize, covalent bonds are usually thought of as things like carbon, hydrogen, nitrogen, halogens, and maybe sulfur. These wonderful atoms make organic compounds which usually "combust" at temperatures approaching, oh, say, about 300 deg C. Metals, on the other hand, can take quite a bit of heat.

---

triple

Because of the Law of Formal Charges (which you may not have covered yet in class), Nitrogen not only wants to achieve the Octet Rule, but it wants to three of its five electrons to form covalent bonds, and ... (proceed to the next half of the question)

---

one

Because of the Law of Formal Charges (which you may not have covered yet in class), Nitrogen not only wants to achieve the Octet Rule, but it wants to three of its five electrons to form covalent bonds, and the remaining two are kept to make one lone pair.

Similarly, each halogen wants one covalent bond and three lone pairs, carbon wants four covalent bonds (no lone pairs), and hydrogen wants one covalent bond (no lone pairs.)

---

less

electronegativity

northeast

ionization energy

electron affinity

negative

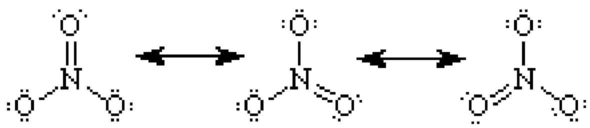
high

LiF

polar

When several Lewis structures are possible, the most stable structure will place a negative formal charge on the most electronegative/electropositive atom.

The nitrate ion, NO3-, the nitrogen is bonded to two oxygen's which are both single bonded to the nitrogen, and also to a third oxygen atom, wich is double bonded to the nitrogen has an overall charge of (-1.)



I can't make the web insert extra spaces so I'll use ampersands.

```
&&&&&&..-&&&&&&&&&&&&&&&&..-&&&&&&&&&&&&&&&&&&&&&&&&&&
&&&&..O..&&&&&&&&&&&&&&..O..&&&&&&&&&&&&&&&..O..&&&&&&
&..&&&|&&&..-&&&&&&-..&&&|&&&..&&&&&&&&-..&&&||&&..-&&
&&O&=&N&-&O..&&&&&&..O&-&N&=&O&&&&&&&&&..O&-&N&-&O&..&
&..&&&+&&..&&&&&&&&&..&&&+&&&..&&&&&&&&&..&&&+&&&&..&&
```

What is so important to note that the positive charge goes on the the very electronegative N (usually nitrogens don't have to put up with accepting positive charges) because oxygen is even more electronegative.

The nitrogen prefers three bonds and one lone pair, but in the nitrate molecule it has four bonds and no lone pairs, so this gives it a +1 formal charge. The two oxygens which each have one bond (and thus three pairs of nonbonding electrons) would prefer instead to have two bonds and two lone pairs, thus each of these oxygens has a -1 formal charge. 2(-1) + 1(+1) = -1.

S shares single bonds with two oxygens and a double bond with the third.

stronger

Bond energies are derived for gaseous molecules and often they are averaged values.

shorter

stronger

zero

the same as its charge.

greater

I kindof don't like this rule; it seems to be one of those rules that takes you 80% of the way, and then all of a sudden lets you down. This rule implies that we can say halogens such as chlorine are always -1, which is always the case in Organic chemistry, but look at the I which is the central atom in Sample Exercise 8.10 on p. 270, and also look at the binary oxides on page 278. About two thirds of the way down the first colume Cl has an oxidation state of +7.

I'm going to speculate here that for any case where chlorine or another halogen can't take -1, that +7 is the only other alternative. Any other halogen oxide would probably need to do the +7 thing since oxygen is always -2.

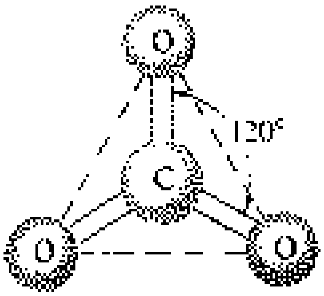
---

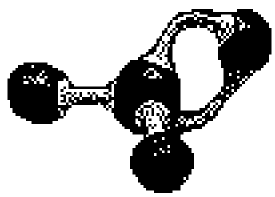
the oxidation number is -1 for the peroxide ion, O2(^-2)

The bond angle of a tetrahedron is ______ degrees.

The best arrangement of a given number of electron pairs is the one that minimizes/ maximizes the repulsions among them.

T or F The molecular geometry is the arrangement of electron pairs around the central atom.

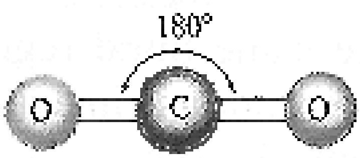


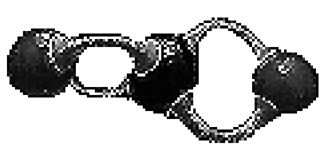


This structure can be described as trigonal planar, tetrahedral, or trigonal pyramidal.

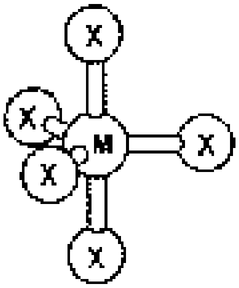
T or F A double or triple bond is counted as one bonding pair when prediciting the geometry.

An example of a linear model would look like this:





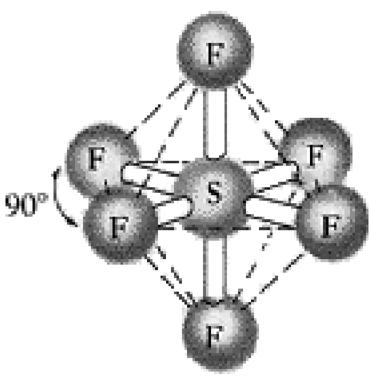
and could possible be increases/decreases as the number of nonbonding electron pairs increases.

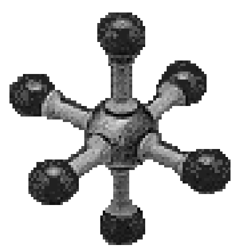


This structure contains more than four electron pairs around it and can be described as equitorial/axial positions.

A molecule has one end with a slight positive charge and one end that is slightly negative. This molecule can be classified as T or F Polar molecules align themselves in an electric field with their negative ends pointing toward the positive plate.

What does the _________?





What are the two types of bonds?

___________.

The bonding sigma molecular orbital is higher/lower in energy than the atomic one-s orbital.

Half of the differece between the number of bonding and antibonding electrons is known as _________ whereas <a href="http:9-20b.html>_________ is a type of magetism that causes a substance with one or more unpaired electrons to be drawn into a magnetic field.

109.5 degress

Minimizes. Electrons arrange themselves like balloons that are tied together.

False. The electron-pair geometry is concerned with this arrangement. The molecular geometry is determined by the arrangement of the atoms in space.

This structure is trigonal planar since it has 3 atoms arranged in one plane around the central atom.

True. A double or triple bond has the same effect on a bond angle as a a single bond.

Lower. The antibonding sigma orbital is higher in energy, though.

Which of the following are greenhouse gases? chlorine, oxygen, acetylene, methane, carbon dioxide?

What is the SI unit of force and what are its units?

What does Boyle's law relate?

What law relates temperature to volume?

---

graph of pressure vs. volume look like?

What is

Avogadro's hypothesis?

What is the Ideal Gas Law?

What are STP conditions?

What is the molar volume of a gas at STP?

What is Dalton's law of partial pressures?

What are the five ideas of the Kinetic-Molecular Theory of Gases? Click on each of the five clue phrases:

gas molecule motion
gas molecule volume
gas molecule intermolecular forces
gas molecule average kinetic energy
gas molecule energy/temperature relationship

What is the equation which relates root mean square speed to temperature?

What is the relationship between rate of effusion and molar mass? Who's name is associated with this physical law?

Deviation from ideality increases as the pressure of a gas decreases/ increases.

Solve the equation below for nRT.

```
...........................
.................2.........
......nRT.......n.a........
.P.=.------..-..---........
.....V.-.nb......2.........
................V..........
...........................
```

carbon dioxide and methane

newton

kilograms meters over seconds squared

pressure and volume

Charles law

The graph of pressure vs. volume is a hyperbola with pressure reaching infinity as volume approaches zero; as volume approaches infinity, pressure drops to zero. When thinking about Boyles law, picture in your mind, a piston pushing on a gas.

Avogadro's Hyopthesis is that equal volumes of gases at the same temperature and pressure contain equal number of molecules.

Avogadro's Law is that the volume of a gas maintained at constant temperature and pressure is directly proportional to the number of moles of the gas.

PV=nRT For freshmen chemistry, usually R is 0.0821 Liters atmospheres over Kelvin moles
However, in physical chemistry, where this a greater push to use SI units, R is 8.31 J per Kelvin mole

---

You should be able to derive a relationship between energy, and pressure multiplied against volume from the above two pieces of information.

0 degrees Celsius and 1 atm

273.15 Kelvin and 760 torr

At standard temperature and pressure, 1 mole of an ideal gas occupies 22.41 L.

Dalton's law of partial pressures states that the total pressure of a mixture of gases equals the sum of the pressures that each would exert if it were present alone.

I wonder if this can be derived from the first law of thermodynamics (conservation of energy); I haven't tried yet.

Gases consist of large numbers of molecules (noble gases can be uncombined atoms) that are in continuou, random motion.

This is sometimes called "Brownian Motion".

The total volume of all the molecules of the gas is negligible compared to the total volume in which the gas is contained.

Attractive and repulsive forces between gas molecules are negligible.

Energy can be transferred between molecules during collisions, but the average kinetic energy of the molecules does not change with time, as long as the temperature of the gas remains constant. Collisions are perfectly elastic.

The average kinetic energy of the molecules is proportional to the absolute temperature. At any given temperature the molecules of a gas (any gas) have the same average kinetic energy.

Root mean square speed = the square root of the expression 3RT over molar mass, where R is the gas constant, and T is the temperature in Kelvin.

It is an inverse square root relationship

---

effusion rate one over effusion rate two equals the square root of the expression molar mass two over molar mass one.

Graham

increases

Real gas molecules are attracted to each other.

If gas molecules were not attracted to each other, we would never see liquification.

```
.............................
../....2.\.../....\..........
.|....n.a.|.|......|.........
.|P.+.---.|.|V.-.nb|.=.nRT...
.|.....2./..|......|.........
..\...V./....\..../..........
.............................
```

What does the 'a' term correct for?

What does the 'b' term correct for?

molecular attractions

molecular volume

Solids that possess highly ordered structures are said to be ________.

(True or False) A gas is an example of a condensed phase.

The expression "Van Der Waals Forces" collectively applies to what three specific types of intermolecular forces?

What is polarizability?

Why does water have such a high boiling point?

Hydrogen bonding is really a special extreme case of the more general intermolecular force, _______, which requires one of three atoms which must be bonded to a hydrogen.

Rank the following in order of increasing strength: covalent bonding/dipole-dipole forces/ hydrogen bonding.

Why does ice float on water?

What is the meaning of viscosity?

What are the two techniques mentioned in the text for measuring viscosity?

Name three factors which influence the viscosity of a liquid

A water meniscus curves downward/upward because the adhesive forces between the water and the glass are stronger than the cohesive forces between the water molecules.

The rise of liquids up capillary tubes is called _________.

```
Below is a phase diagram

..........................
..........2..............3
p.........................
```

```
r...A..../.....B....../...
e................./......
s......./....../.........
s.......1../.............
u....../.................
r...../........C.........
e..../...................
.........................
......temperature........
```

The solid phase is located at (A/B/C), the gas phase is located at (A/B/C), the triple point is located at (1/2/3), and the critical point is located at (1/2/3).

Below is a plot of temperature for a substance as a function of heat energy input which goes through the three phases.

```
..............................F...........
t............................/............
e..............D___________E.............
m............./.........................
p............/..........................
e.........../...........................
r........../............................
a........./.............................
t.....B___C.............................
u.../...................................
r../....................................
e../....................................
..A......energy.........................
```

Where do each of the following occur?

- boiling
- condensation
- evaporation
- melting
- sublimation

fusion/freezing

What is the meaning of critical temperature and critical pressure.

What is the textbook definition of vapor pressure?

Name the various variables and mathematical functions of variables of a Clausius-Clapeyron plot:

the independent axis
the dependent axis
the slope
the y-intercept

For a unit cell, (a,b,c or alpha, beta, gamma) are cell lengths and (a,b,c or alhpa, beta, gamma) are angles between edges.

Sodium Chloride is (primitive cubic/ body-centered cubic/ face-centered cubic.

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crystalline

false

dipole-dipole forces
London dispersion forces (a.k.a. induced-dipole induced dipole)
hydrogen bonding

The ease with which the charge distribution in a molecule can be distorted by an external field.

because of hydrogen bonding between the oxygen of one water molecule, and the hydrogen bonded to an oxygen on a different water molecule.

dipole-dipole attraction

fluorine
oxygen
nitrogen

dipole-dipole forces < hydrogen bonding < covalent bonding

Note earlier hydrogen bonding was called an extreme case of dipole-dipole forces, but often authors (and test makers) treat it as a separate thing.

water has a higher density than ice because ice packs in a structure that "wastes" space.

Viscosity is the resistance of a liquid to flow.

The two techniques are:

1. **Timing how long it takes a given volume of the liquid to drain through a tube under gravitational force.**
2. **Measuring the rate at which steel spheres fall through the liquid.**

1. **The attractive forces between the liquid molecules. Viscosity increases with increasing attractive forces.**

2. **Structural features which can cause entanglement. Increasing entanglement increases viscosity.**

3. **The temperature of the system. Viscosity increases with increasing temperature.**

Item 3 ties in with item 1 if you thing about it.

Item 2 is important because a polymer consisting of a long chain many carbons bonded together (sometimes organic chemists draw structures but don't bother to show hydrogens)

C-C-C-C-C-C-C-C-C-C-...-C-C-C-C-C-C-C-C-C-C

and surrounded by hydrogens

CH3-CH2-CH2-CH2-CH2-...CH2-CH2-CH2-CH2-CH2-CH3

will have a viscosity that increases, the longer you make the chain. It is thereby possible for an engineer to have some idea of the molecular weight (how long the chain is) by doing a viscosity test.

It should make sense from the octet rule and formal charge that end carbons on a hydrocarbon chain can bond to one carbon an three hydrogens, and carbons not on the end can bond to two carbons and two hydrogens.

downward

capillary action

A

C

The textbook defines the triple point as the temperature and pressure at which all three phases (gas/liquid/solid) are in equilbrium.

An alternate way to think of this is that in a closed container with the liquid and the solid, the triple point is the temperature and pressure that the system will maintain as long as all three phases are present.

1

3

from E to F

from F to E

The heating curve doesn't account for evaporation.

from B to C

like evaporation, it doesn't really fit on this table either

---

the critical temperature is the temperature above which a substance cannot be liquified regardless of how much pressure is applied.

The critical pressure is the pressure required to cause liquefaction at the critical temperature.

The independent axis is reciprocal temperature (1/T)

the dependent axis is the natural log of pressure (ln P)

the slope is the enthalpy of vaporization divided by the gas constant

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you will probably use the S.I. 8.3145 J per mol K gas constant

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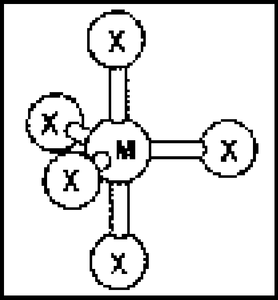
note that the slope of the graph is negative

the y-intercept of the graph is is a constant that your book does not explain

a,b,c

alpha, beta, gamma

face-centered cubic


X
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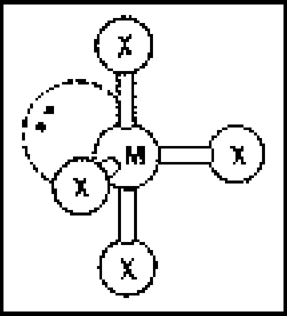
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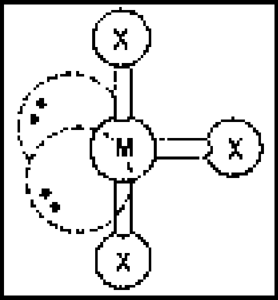
X
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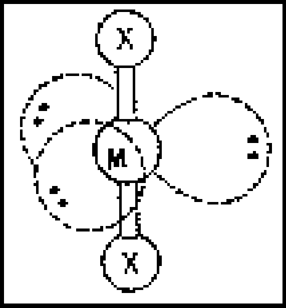
X
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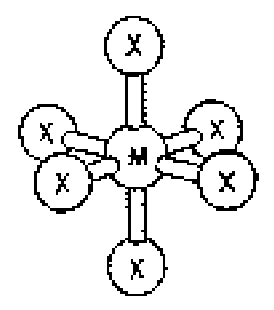
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X
X
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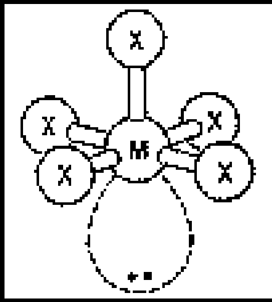
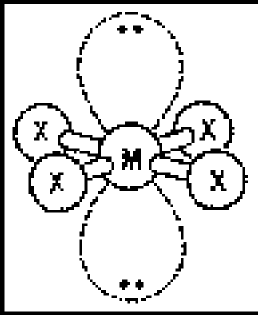
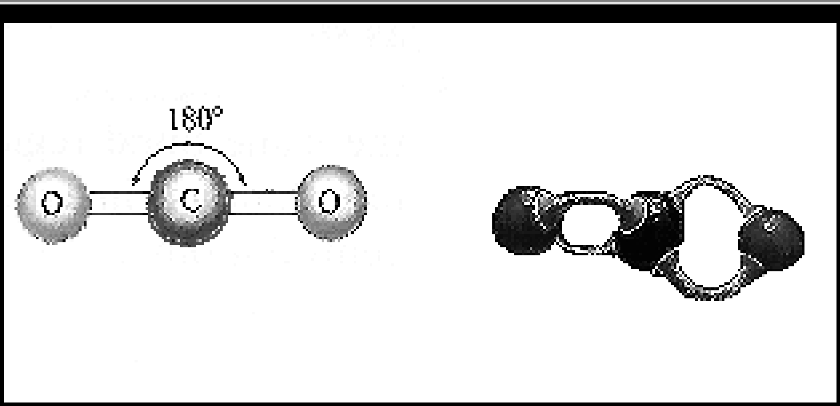
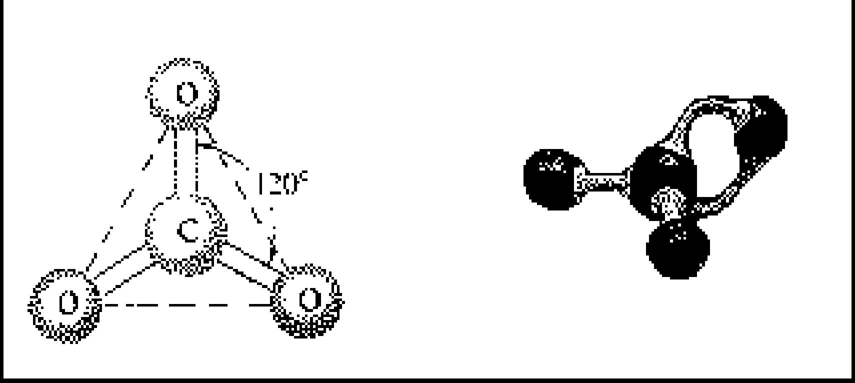


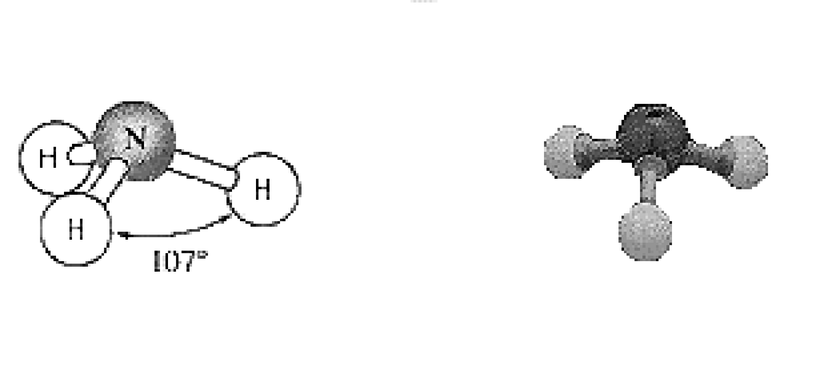




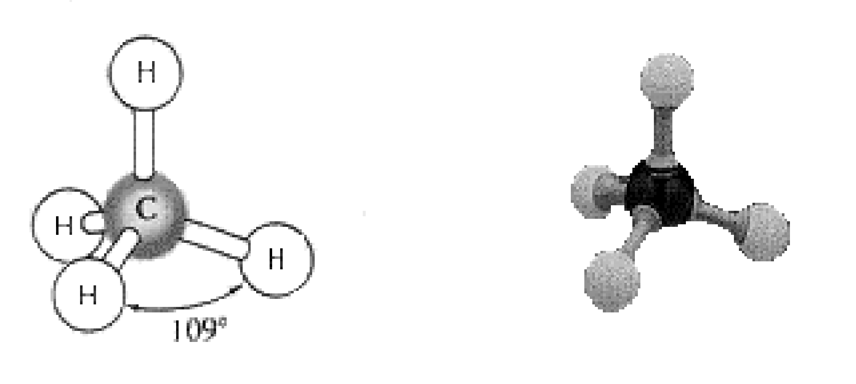
TESO DOS BICHOS...



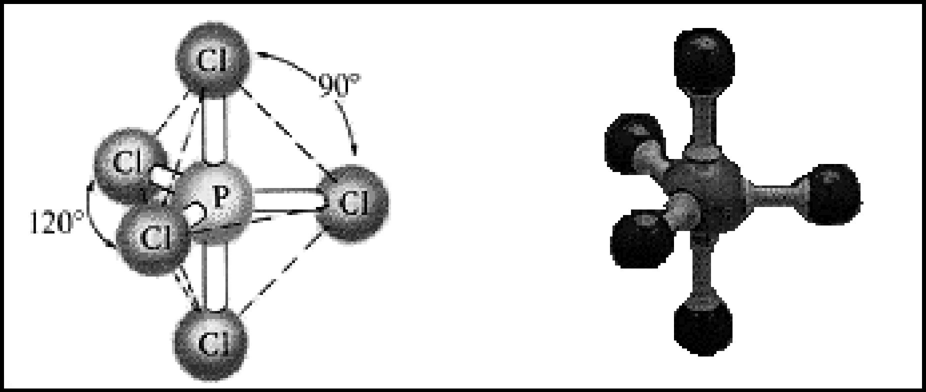
WHAT HAPPENED AT ROSWELL IN 1947?



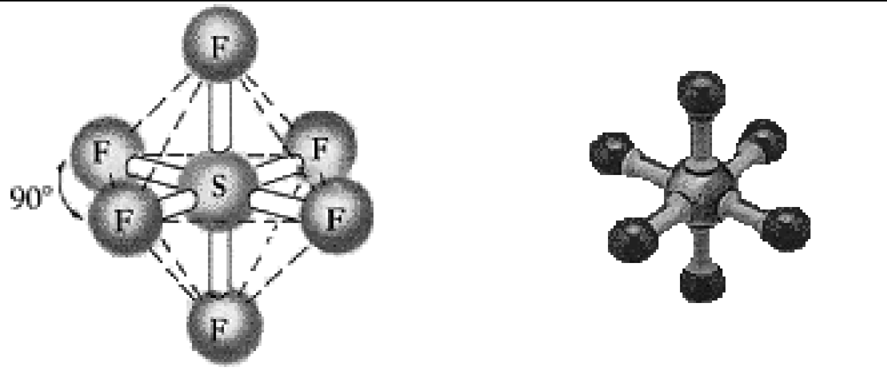
TRUST NO ONE...



DENY EVERYTHING...



I WANT TO BELIEVE...



THE TRUTH IS OUT THERE...

Sorry, I found this file that was used to collect the gif files, and I just went crazy.